Mycological Notes.—V

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The notes for the present issue have this in common that they are all derived from the results obtained at the Experiment Area of the New Jersey Experiment Station. This test field, sometimes called the "Plant Hospital," consists of two acres laid off into six series, each with four plots and the latter are all divided into six equal parts 11 by 33 feet and called belts. These belts are usually the unit of area for any variation in the method of treatment for the crop in the plot.

Nearly all the vegetable and vegetable-fruit crops are grown, some one or more fungi infesting each being under consideration. In some instances the treatment is entirely with the soil, as for club-root of turnip, or scab of the round potato, but in the majority of cases it is by means of various fungicides applied to the aerial portions of the plant, as in the spraying of beets for leaf blight (*Cercospora beticola* Sacc.) or beans for the pod spot (*Colletotrichum lagenarum* Pass.).

The present season closed the fifth year in the existence of these experiment grounds and during all that time some crops have been grown continuously upon the same land. The work with the turnip club-root (*Plasmodiophora Brassicae* Wor.) is a good instance of this latter fact and may well serve as the first note to be recorded.

Lime for the Club-root of Turnips.—Experiments with lime as a remedy for the club-root, due to the subterranean *Myxomycete*, above named, have been carried out upon one plot, one-twentieth of an acre, and divided into six equal belts. Lime, air slaked, was used upon three of the belts, namely numbers 1, 3 and 5, and at the rate of 150, 75 and 37½ bushels per acre respectively, applied April 24, 1894, to the surface of the ground already prepared for sowing, and thoroughly raked in. Belt number 6 received corrosive sublimate and its consideration will be omitted at this time.

The following table gives the yield of turnips in terms of pounds, and sound and clubbed roots for each of the past five years, no additional lime having been applied during that time.

Year	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed
1894	99	2	95	37	75	11	101	14	120	3	127	11
1895	53	1	42	81	135	7	91	36	132	5	79	54
1896	91	0	1	90	87	1	25	65	77	1	22	56
1897	115	0	34	81	117	1			124	4	151	44
1898	86	0	14	77	77	2	64	34	68	1	67	28
Total	444	3	186	366	491	22	281	149	521	14	503	156

It is seen that the amount of diseased roots was much less upon the limed than the unlimed belts. It will be fair to take the first four plots thus dealing with equal areas with lime and without, and under these conditions it is seen that the two limed belts in 1894 gave 13 pounds of clubbed roots to 51 pounds when no treatment was made. The next year shows a greater difference in favor of the limed belts, for in 1895 the yield of diseased roots stood for the treated 8 pounds to 117 pounds for the untreated belts.

In 1896 there was one pound to 155 in favor of the limed belts, and in 1897 the results were practically the same, here, however, one of the check belts was employed for testing the susceptibility of other cruciferae to the *Plasmodiophora*. In 1898 there were two pounds of clubbed roots upon the limed belts to 111 where there was no treatment.

It is seen from the table that the larger amount of lime (belt 1) produced only 3 pounds of clubbed turnips and the half amount of lime (belt 3) yielded 22 pounds, which exceeded the belt with a quarter amount of the lime, namely, 37½ bushels per acre. From this test for five years it seems that 35 bushels of lime per acre is ample to keep the club-root from the land even when the susceptible crop is grown continuously, and two crops each season for at least five years without diminished strength.

By combining the two treated and two check belts the following table is constructed:

	Limited Belts.		Untreated Belts.	
Year.	Sound.	Clubbed.	Sound.	Clubbed.
1894	174	13	196	51
1895	188	8	133	117
1896	178	1	26	155
1897	232	1	68	(162) estimated.
1898	163	2	78	111
Totals.	935	25	501	596

It is seen from this that in a field when the diseased roots outweigh the sound ones, the presence of lime in the soil has the wholesome effect of reducing the disease to near four per cent. of its abundance upon untreated land.

It should be said in addition that under the method of inspection any root that showed the slightest indication of the club-root fungus was excluded from the group of sound specimens and, therefore, this was a discrimination against the treatment, for the diseased roots grown in the limed land were usually only infested to a small extent, while those upon the untreated soil were, as a rule, badly diseased and frequently offensive and of course unmarketable.

Artificial Introduction of Onion Smut.—Smut-infested soil was obtained from a field of a large onion grower in the southern part of the State where *Urocystis cepulae* Fr., had been so fatal that the growing of onions was abandoned. The dry soil thus obtained was added to the open row before the onion seed had been sown and an equal amount upon the covered row, making in all one bushel of the soil to the belt or at the rate of 120 bushels per acre. The seed was sown upon April 23d, and owing to unfavorable weather, germination was slow and the smutted seedlings were first found upon June 8th, and in abundance; but only in the belt where the soil had received the earth from the far away old onion field. A white variety "Pearl" and a red variety "Red Weathersfield" were in alternate rows, and there seemed to be no difference in susceptibility between the two kinds. No smutted onions were found outside of the belt under treatment, which indicates that the disease does not spread rapidly over the field unless the soil is transported, which may be by implements of culture, by winds or the flow of water over the surface of the soil. It is demonstrated that the smut germs can be artificially transferred, very effectively, in small amounts of soil and onion growers should bear the fact in mind in contending with this serious enemy.

The Beet Leaf Blight as a Test for Fungicides.—The beet has been grown in the Experiment Area for the past five years, and is found with us to be one of the best plants for testing of fungicides. There are two fungous diseases that infest the foliage in particular and one of these, *Cercospora beticola* Sacc., is so abundant as to be

safely counted upon as being present. The beet plant is a quick growing annual that lends itself especially well to plot experiments; it is low-growing, a habit of considerable importance in spraying; the leaves are large and the disease is conspicuous. Use has been made of nearly all of the full list of the more common vegetables and vegetable-fruit plants and none of them are equal to the beet as a subject for testing the application of fungicides.

During 1894, the first year that beets were grown upon the Experiment Area, only Mangel wurzels were grown and the Bordeaux mixture gave an increase over the check of 26 per cent. In 1896 four kinds of Bordeaux, namely, the ordinary sort made with lime was used as a standard with which was compared three other kinds, namely, soda-bordeaux, potash-bordeaux and ammonia-bordeaux, the lime being replaced with other alkalies, soda, potash and ammonia respectively. In this year the increase in crop accredited to the Bordeaux mixture was 46.5 per cent. for the roots and 77.5 per cent. for the foliage and these were exceeded by the potash-bordeaux which gave 47.5 per cent. gain in roots and 78.5 per cent. of leaves.

In 1897 five varieties of beets were grown in order to study the susceptibility of the different sorts to the blight and the relative effects the various fungicides might have upon them. Out of this list the three following were selected for further use, namely, "Long blood-red," "Swiss chard" and "Long Mangel wurzel" as representing three widely separated types of beets. In passing it may be mentioned that the "Swiss chard" is a form of beet producing small roots and a large development of leaves with broad etiolated petioles that become the edible portion of the plant. This variety blights badly and becomes a better test of the value of a fungicide than beets of the ordinary sort where the root-weight is the deciding point. In short, the experience of the five years in finding the most suitable plant upon which to experiment with fungicides has led gradually to the acceptance of the beets and of these the "Swiss chard" is the one of greatest value.

During 1898, the "Chard" in the belts sprayed with Bordeaux and the soda-bordeaux were conspicuous for their comparative freedom from blight and the latter was somewhat ahead of the Bordeaux mixture. This soda-bordeaux is made accord-

ing to the following formula: soda, 1 pound (a pound can of Lewis' Lye, for example); copper sulphate, 3 pounds; lime, 5 ounces; water, 30 gallons.

In order to prevent the mixture turning brown (which does not, however, lessen its efficiency but discolors the treated plant) a small quantity of lime is used to neutralize any excess of acid and in this way a permanent bluish-colored solution is obtained. The advantage claimed for this combination is the absence of the large amount of the lime in the ordinary Bordeaux mixture, and it may prove of considerable value in spraying in the fruit garden and vineyard, in particular when the fruit is nearing full size and a clear fungicide does not leave a serious stain upon the fruit. The ease with which the compound may be made and the absence of any danger of clogging the spraying machine commend the mixture to the practical mind.

Susceptibility of Bush Beans to Blight.—Four varieties of bush beans were under experimentation the present season, namely the "Green Flagolet," "Golden Wax," "Early Refugee" and "Saddleback Wax." Two plots were employed, one of them having been in beans continuously since the spring of 1894, two crops each year, and therefore the present season produced the ninth and tenth successive crops. The other plot was of land that had not been in beans for many years, if ever before. Upon the old land the "Refugee" proved the most productive and the "Flagolet" the least, but in spotted pods the results were reversed.

The new land carried a duplicate of the experiment of the one upon the old land, and here the "Refugee" proved the most productive and least susceptible to the disease. If one were seeking a variety to furnish an abundance of disease, for experimental purposes, he could scarcely go amiss in selecting the "Flagolet," while, on the other hand, the "Refugee" would be less acceptable. In foliage the "Flagolet" is exceedingly tender, and from the time the first true leaf appears there is more or less blight in sight.

With the second or autumn crop the same record is made, namely that the "Flagolet" leads all other varieties in susceptibility to the blight. From this and the experience of other years this sort may be considered as one of weak resistant power.

Sweet Corn Smut and Bacterial Disease.—Several varieties of

sweet corn were grown, only one of which has shown unmistakable signs of the bacterial disease (*Pseudomonas Stewarti* E. F. Smith), namely, "First of all." This is a very small form, the chief merit of which is its earliness. A second crop grown with the stubble of the first had some of the plants decay away at the base, due to the bacteriosis.

Smut (*Ustilago maydis* DC.) was quite abundant upon the same variety, and like the *Pseudomonas* was rarely met with elsewhere in the plot where four other varieties of sweet corn were grown.

Rotation of Crops a valuable Fungicide.—The fairly well known fact stated in the headline was brought strikingly to the attention of the writer in an experiment with egg-plants. One plot had been in this crop for three successive years, and a half of it was again set to egg-plants for 1898. A duplicate set of plants was placed upon a half plot of land where that crop probably had never been grown. The treatment as to culture and kinds and times of spraying were the same upon the two areas, and the results are shown in the following table:

New Ground.	Marketable.	Small.	Total.
Sound fruits.	130	80	210
Decayed fruits.	21	19	40
Old Ground.			
Sound fruits.	27	15	42
Decayed fruits.	21	45	66

There were five times as many sound fruits upon the new as upon the old land, while the decayed ones were only 16 per cent. upon the new land and 61 per cent. upon the old land. The point of special interest in this connection was that nine sprayings were made with Bordeaux upon one row of each of the half plots and this mixture was not able to keep the plants in the old land in good health. In short, a crop may be continued so long upon the same land that a fungicide may fail to do its effective work, when a resort to some other crop is the only practical method of dealing with the troubles.

Sulphur as a Remedy for Potato Diseases.—Sulphur was added to five of the twenty-four belts of land in one portion of the Experiment Area devoted to tests for a remedy for the Potato Scab (*Oospora scabies* Thax.).

The following table shows the amounts of sulphur per acre, and the time of application :

Plot	I	Belt	2	120 lbs.	1896	480 lbs.	1898 =	600 lbs.	Scab	28.33	%
"	II	"	2	240 "	"	240 "	"	480 "	"	31.66	%
"	III	"	2	600 "	"			600 "	"	36.66	%
"	III	"	6			480 "	"	480 "	"	20.00	%
"	IV	"	6	300 "	1895			300 "	"	10.00	%
						Average				25.33	%

All of the "seed" for the whole field, except that of certain check belts, was soaked twice for one hour each in the standard solution of corrosive sublimate and this operation reduced the scab 8½ %. After making this allowance for the corrosive sublimate the sulphur still further reduced the scab from 52 to 25.33 per cent., or to less than half of the average of the unsulphured belts.

In another part of the Experiment Area there were eighteen belts of land in potatoes, and here the three untreated belts gave 63.30 per cent; of scab. There were four belts to which sulphur was added in equal amounts, but at different times, as follows :

	Belt 1.	3	5	6
In 1896.	240 lbs.	480 lbs.		360 lbs.
In 1898	480 "	240 "	720 lbs.	360 "
Total.	720 "	720 "	720 "	720 "

The average percentage of scab upon these four belts is 12.50% or 50.80% below that upon the untreated belts.

One other test was made with sulphur for potato scab, namely in a plot where turnips had been grown for four years continuously, two crops each year, and sulphur at the rate of 1,200 pounds per acre had been added to one belt in 1896.

After an interval of many years since potatoes had been upon this land the scab was abundant, averaging 80% for the five belts not bearing sulphur, while the treated one showed only 35%, and three quarters of this was upon the row adjoining a belt where the scab was recorded as being 90%.

The three above experiments show that in one instance sulphur reduced the amount of scab after the "seed" had been soaked twice in corrosive sublimate from 52% to 25.33%, in the second case from 63.30% to 12.50% and in the last from 80% to 35%. An average of these results shows a reduction of the scab from 65.10% to 24.27%.